

I/O Ports and Devices

This chapter presents PC 99 requirements and recommendations for I/O ports and devices, including serial and parallel ports, wireless capabilities, and input devices and connectors.

In general, system designers are encouraged to consider solutions such as USB rather than traditional connections for external devices. USB support is required for PC 99 systems, and easy connectivity is important in situations where devices might be interchanged on a regular basis. System designers are encouraged to take advantage of USB, which will replace legacy serial and parallel ports in the near future.

Legacy and proprietary game-pad solutions are not acceptable for PC 99. Game pads, joysticks, and other input devices must be implemented as USB devices.

Contents

System Requirements I/O Ports and Devices	2
Serial Port Requirements.....	4
Non-legacy Serial Port Requirements	4
Legacy Serial Port Requirements	5
PC 99 Parallel Port Requirements	6
Non-legacy Parallel Port Requirements.....	6
Legacy Parallel Port Requirements	6
Mouse Port and Peripheral Requirements	9
Keyboard Port and Peripheral Requirements	11
Game Controller Requirements.....	13
Wireless Component Requirements	13
IR Requirements.....	15
RF Recommendations	17
PC 99 Design Features for Ports	18
Plug and Play and Bus Design for I/O Ports and Devices	18
Power Management for I/O Ports and Devices	19
Device Drivers and Installation for I/O Ports and Devices.....	20
References for I/O Ports and Devices	21
Checklist for I/O Ports and Devices	22

System Requirements I/O Ports and Devices

This section summarizes PC 99 requirements for serial and parallel ports.

1. System includes connection for external serial devices

<i>Consumer PC 99</i>	<i>Office PC 99</i>	<i>Entertainment PC 99</i>
-----------------------	---------------------	----------------------------

<i>Required</i>	<i>Required</i>	<i>Required</i>
-----------------	-----------------	-----------------

Recommended: USB or PC Card.

This capability can also be provided as a 16550A serial port or as equivalent I/O capabilities in the system. If a legacy serial port is implemented in a PC 99 system, it must meet the requirements defined in this chapter. If two legacy serial ports are implemented, additional requirements are defined.

For Net PC systems and Office PC 99 systems, remote management capabilities must be implemented as defined in *Network PC System Design Guidelines*.

2. System includes connection for external parallel devices

<i>Consumer PC 99</i>	<i>Office PC 99</i>	<i>Entertainment PC 99</i>
-----------------------	---------------------	----------------------------

<i>Required</i>	<i>Required</i>	<i>Required</i>
-----------------	-----------------	-----------------

Recommended: USB, IEEE 1394, or PC Card.

This connection can also be provided as a parallel port with ECP-mode capabilities. If a legacy port is implemented in a PC 99 system, it must meet the requirements defined in this chapter.

For an Office PC 99 system or a Net PC system, if a parallel port is present, it must be implemented as an ECP-mode parallel port, and remote management capabilities must be implemented as defined in *Network PC System Design Guidelines*. On a DEC Alpha system, the keyboard must work as the input device using the Advanced RISC computing (ARC) interfaces.

3. System includes external connection for keyboard

<i>Consumer PC 99</i>	<i>Office PC 99</i>	<i>Entertainment PC 99</i>
-----------------------	---------------------	----------------------------

<i>Required</i>	<i>Required</i>	<i>Required</i>
-----------------	-----------------	-----------------

Recommended: USB.

Although USB is the preferred solution, this connection can also be implemented as a PS/2-style port or by using wireless capabilities in the system.

Mobile PC Note

For a mobile PC, the required USB port can be used to support the requirement for an external pointing device and keyboard connections. However, two PS/2-style ports can be implemented for the pointing device and keyboard, or a single PS/2-style port can be provided for both the pointing device and the keyboard. If a single PS/2-style port is used, the design must include two separate

clocks and two separate data lines, and a special cable must be provided that allows both the external keyboard and pointing device to use the single port.

4. System includes pointing-device connection and pointing device

<i>Consumer PC 99</i>	<i>Office PC 99</i>	<i>Entertainment PC 99</i>
<i>Required</i>	<i>Required</i>	<i>Required</i>

Recommended: USB or wireless.

Although USB is the preferred solution, this connection can also be implemented using a PS/2-style port.

Mobile PC Note

See the “System includes external connection for keyboard” requirement earlier in this section for issues related to mobile PCs.

5. System includes USB game pad or joystick

<i>Consumer PC 99</i>	<i>Office PC 99</i>	<i>Entertainment PC 99</i>
<i>Recommended</i>	<i>Recommended</i>	<i>Recommended; wireless</i>

This device must support the *USB Human Interface Device Class Specification, Version 1.0* or later. For more information about requirements for USB peripherals, see the “USB” chapter in Part 3 of this guide.

Important: No devices that use legacy or proprietary ports can be included in a PC 99 system.

6. System includes built-in wireless capabilities

<i>Consumer PC 99</i>	<i>Office PC 99</i>	<i>Entertainment PC 99</i>
<i>Recommended</i>	<i>Recommended</i>	<i>Recommended</i>

Wireless capabilities can be provided as built-in capabilities in the system or by using PC Card, IEEE 1394, or USB. If wireless capabilities are included in the system, PC 99 requirements must be met as defined in the “Wireless Component Requirements” section later in this chapter.

7. Devices use USB or external bus connections rather than legacy serial or parallel ports

<i>Consumer PC 99</i>	<i>Office PC 99</i>	<i>Entertainment PC 99</i>
<i>Required</i>	<i>Recommended</i>	<i>Required</i>

This will become a requirement for all system types in future versions of these guidelines.

Although legacy LPT and COM ports can be provided on a PC 99 system, no devices except printers should be provided with a system that uses these ports. For PC 99, a legacy serial port cannot be used as the connection for the mouse or modem.

8. All devices meet PC 99 general device requirements

<i>Consumer PC 99</i>	<i>Office PC 99</i>	<i>Entertainment PC 99</i>
<i>Required</i>	<i>Required</i>	<i>Required</i>

These include the requirements for a device ID, automated software-only settings for device configuration, device drivers and Windows-based installation, and icons for external connectors. For more information, see the “PC 99 Basic Requirements” chapter in Part 2 of this guide.

Serial Port Requirements

Serial ports have been used on computers for decades. In the past, standard baud rates for most serial ports were around 19.2K. Now that systems and peripherals have become more demanding, higher-speed devices are necessary to meet the needs of the newest generation of serial ports.

This section summarizes the hardware design features for PC 99 serial ports. The PC 99 general device requirements are defined in the “System Requirements for I/O Ports and Devices” section earlier in this chapter, including the requirements for a device ID, automated software-only settings for device configuration, device drivers and Windows-based installation, and icons for external connectors.

Non-legacy Serial Port Requirements

This section defines PC 99 requirements for non-legacy implementations in support of serial port capabilities.

9. Serial port meets device class specifications for its bus

Required

As required for all PC 99 devices, a serial port implementation that uses a non-legacy bus must meet the specific device class requirements for that bus.

For example, a USB serial port implementation must comply with all related USB specifications, including:

- *Universal Serial Bus Specification, Version 1.0* or later (also known as the USB core specification)
- *Universal Serial Bus Device Class Definition for Communication Devices, Version 1.0* or later

The “Standard Serial Interface Circuit Emulation” appendix in the *USB Device Class Definition for Communication Devices* specifically addresses serial-port compatibility.

Legacy Serial Port Requirements

This section defines PC 99 requirements for legacy serial ports. Legacy ports are not recommended for PC 99 systems, but if implemented, such ports must meet the requirements defined in this section.

10. Legacy serial port is implemented as 16550A UART or equivalent and supports 115.2K baud

Required

A 16550A buffered Universal Asynchronous Receiver/Transmitter (UART) or equivalent buffered legacy serial port is required to support high-speed communications while reducing the CPU requirements for servicing the device. The device must be able to support 115.2K baud.

11. Legacy serial port supports flexible resource configuration and dynamic disable capabilities

Required

A legacy serial port must provide flexible resource configuration and complete dynamic disable capabilities as defined in the *Plug and Play External COM Device Specification, Version 1.0*.

These are the recommended resource settings for non-PCI devices:

- Four I/O locations for each port, where the standard ISA I/O addresses are 3F8h, 2F8h, 3E8h, 2E8h. Using the standard addresses ensures the proper functioning of software that directly addresses these locations.
- Two IRQ signals, where the standard is programmable interrupt controller-based (PIC-based) IRQ 3, IRQ 4. Using the standard IRQ signals ensures the proper functioning of software written for systems that use standard IRQ signals.

Two IRQs are required for each port. If two serial ports are implemented in the system, the IRQs can be assigned as follows:

- For serial port A: PIC-based IRQ 4 and IRQ 11
- For serial port B: PIC-based IRQ 3 and IRQ 10

An IR adapter port might replace a serial port in a system. In such a case, the IR port should use the resource configuration that would otherwise be assigned to the second serial port.

Notice that, as for all devices, IRQ sharing is required if the minimum resource requirement cannot be met.

12. Conflict resolution for legacy serial port ensures availability of at least one serial port*Required*

In the event of an irreconcilable conflict with other serial ports on the system, a legacy serial port must be capable of being disabled by Plug and Play software. This allows at least one of the two conflicting serial ports to operate correctly.

PC 99 Parallel Port Requirements

This section summarizes the basic PC 99 design features for parallel ports and peripherals. Each parallel port on a PC 99 system must meet the requirements listed in this section. The PC 99 general device requirements are defined in the “System Requirements for I/O Ports and Devices” section earlier in this chapter, including the requirements for a device ID, automated software-only settings for device configuration, device drivers and Windows-based installation, and icons for external connectors.

Non-legacy Parallel Port Requirements

This section defines PC 99 requirements for recommended non-legacy implementations to support parallel port capabilities.

13. Parallel port meets device class specifications for its bus*Required*

As required for all PC 99 devices, a parallel port implementation that uses a non-legacy bus must meet the specific device class requirements for that bus.

For example, a parallel port implementation that uses USB must comply with all related USB specifications, including the USB core specification and any specific device class specification.

Legacy Parallel Port Requirements

This section defines PC 99 requirements for legacy parallel ports.

14. Flexible resource configuration supported for each parallel port*Required*

A legacy parallel port must provide flexible resource configuration following the *Plug and Play Parallel Port Device Specification, Version 1.0b*. Resource requirements must be met for each device of this type on the system. The requirements cannot be split between two ports on the system.

For non-PCI devices, the following are the minimum resource requirements for each parallel port on the system:

- Required: Support ISA I/O addresses of 378h and 278h, plus 3BC or a vendor-assigned I/O address. Using these standard I/O addresses ensures

proper functioning of software written for operating systems that directly address these locations.

Recommended: Map the base I/O address to four additional locations.

- Required: Support PIC-based IRQ 5 and IRQ 7. Using these standard IRQs ensures proper functioning of software written for operating systems that use standard IRQ signals.

Recommended: Support five additional IRQ signals.

- Required: Support two unique DMA channel selections if the parallel port design supports block data transfers to memory using DMA controllers. Notice also that the DMA function will not work on a parallel port without an IRQ because the end of a DMA transfer is signaled by an interrupt.

To ensure Plug and Play support for resolution of resource conflicts, a full list of options for all possible configuration combinations must be enumerated, including:

- Options for both ECP mode (which requires an I/O address, an IRQ, and a DMA selection) and standard LPT mode (which requires only an I/O address).
- Options that specify only the I/O address, allowing Windows to assign the IRQ and DMA channel.

On Intel Architecture systems, the operating system considers the parallel port base address (/) stored in the first BIOS Data Area (BDA) locations to be LPT1. The address stored in the second location is LPT2, and so on. On DEC Alpha systems, the information is in the ARC tree. On all ACPI-based systems, the information is obtained through the ACPI tree.

15. EPP support does not use restricted I/O addresses

Required

Some enhanced parallel port (EPP) implementations require eight contiguous I/O ports. If EPP support is implemented, the hardware cannot use the ISA I/O address 3BCh as a base I/O address because VGA devices require use of port 3C0h.

16. Compatibility, nibble mode, and ECP protocols meet IEEE 1284-1994 specifications

Required

Support for a parallel port must include, at minimum, the compatibility-mode and nibble-mode protocols required by the IEEE 1284-1994 specification. This allows other IEEE 1284-compliant devices to be connected without problems.

The port must also support the ECP protocol as defined by IEEE 1284 to allow connections with higher-speed parallel peripherals.

17. Port connectors meet IEEE 1284-I specifications, minimum*Required*

IEEE 1284-I-compliant ports use a standard DB25 connector found on existing system parallel port designs. This is called an IEEE 1284-A connector in the specification.

IEEE 1284-II-compliant ports use an IEEE 1284-C connector. This connector is used on both the port and the peripheral device.

The parallel port design must provide enough space between the connectors and the surrounding enclosure to allow for a mating connector, connector shell, and latch assembly. The IEEE 1284 specification recommends an IEEE 1284-C connector for all new ports and devices.

18. IEEE 1284 peripherals have Plug and Play device IDs*Required*

The device ID is described fully in the IEEE 1284 specification. All characters in the device identification string must consist only of ASCII values 20h–7Fh. The device identification string consists of a leading zero (0), a hexadecimal value that represents the length of the string, and then a set of fields, in ASCII, with a unique identification string.

For PC 99, in addition to the requirements specified in *Plug and Play Parallel Port Device Specification, Version 1.0b*, the device ID string must contain the following keys, at minimum. The keys are case-sensitive and can be abbreviated in INF files as indicated.

Key	Abbreviated string
MANUFACTURER	MFG
MODEL	MDL
CLASS	CLS
DESCRIPTION	DES

All MANUFACTURER and MODEL key values must remain unique for each manufacturer. All MANUFACTURER, MODEL, CLASS, and DESCRIPTION key values must remain static for a specific unit (that is, ID values do not change for different hardware configurations). For example, a user simply adding a memory module to a printer should not change the MODEL key value reported as part of the device ID. However, if the user adds memory by installing an upgrade kit that requires a different driver or requires the existing driver to behave differently, then changing the MODEL value is acceptable as part of the upgrade installation process.

The CLASS key describes the type of parallel device. The CLASS key can contain the values PRINTER, MODEM, NET, HDC, PCMCIA, MEDIA, FDC,

PORTS, SCANNER, or DIGCAM. HDC refers to hard disk controller. MEDIA refers to any multimedia device. FDC refers to floppy disk controller.

The DESCRIPTION key is an ASCII string of up to 128 characters that contains a description of the device the manufacturer wants to have presented if a device driver is not found for the peripheral.

For information about how the system determines the correct peripheral device driver, see the Windows and Windows NT DDKs.

19. Device identification string provides CompatibleID key

Recommended

The CompatibleID (CID) key can provide a value that exactly matches a peripheral name supported by a device driver shipped with Windows. The value must match a value listed in the device's INF file.

20. Daisy-chained parallel port device complies with IEEE 1284.3

Recommended

Windows NT can support a daisy-chained parallel port device if that device complies with the IEEE 1284.3 specification.

Mouse Port and Peripheral Requirements

This section defines the specific PC 99 requirements for pointing-device connections and peripherals. Because the Windows and Windows NT operating systems require a pointing device, a PC 99 system board should include an auxiliary port for an external pointing device (most commonly a mouse). For PC 99, it is recommended that systems designers use the USB port for the connection and also that they consider implementing wireless support for an external pointing device.

The PC 99 general device requirements are defined in the “System Requirements for I/O Ports and Devices” section earlier in this chapter, including the requirements for a device ID, automated software-only settings for device configuration, device drivers and Windows-based installation, and icons for external connectors.

For wireless-capabilities requirements, see the “Wireless Component Requirements” section later in this chapter.

21. Pointing-device connection meets requirements for its bus class

Required

The following requirements must be met, depending on the connection type used in the system. These requirements ensure that all Plug and Play requirements are met and that Microsoft drivers support this device.

If a PS/2-style port is used, the following requirements must be met:

- Comply in full with requirements in *Personal System/2 Specification*, by IBM.
- Use an 8042 chip (or equivalent) to ensure compatibility with Windows. In most cases, the existing 8042 keyboard port is sufficient. The 8042 chip initiates a PIC-based IRQ 12 interrupt when the pointing device is connected to the port.
- Support PCI-based IRQ 12 to ensure the proper functioning of software written for legacy systems that use this IRQ signal.
- Return expected codes, including send ID (0F2h) and response ACK (0FAh), plus 1-byte ID.

If a USB port is used, the following requirements must be met:

- Meet requirements in *USB Specification, Version 1.0* or later
- Meet requirements in *USB Human Interface Device Class Specifications, Version 1.0* or later
- Implement minidriver support based on WDM Human Interface Device (HID) class support in the operating system, as defined in the Windows NT 5.0 DDK.

22. Remote control provides PC 99 minimum support

Recommended

If a remote-control device is provided with a PC 99 system, the range of functions implemented on the device will depend on whether the remote control is designed for the business desktop or for the Entertainment PC 99.

There is no defined list of functions that must be included on a remote-control device, but such a device might provide the following types of functions and buttons:

- Power button that turns devices on and off.
- Start button, such as the Windows logo key, that causes a Start menu to be displayed. For information about the Windows logo key, see the “Keyboard Port and Peripheral Requirements” section later in this chapter.
- Menu button that causes an application-specific menu to be displayed.
- Help button that causes application-specific Help file to be displayed.
- Directional capabilities, which function similarly to the arrow keys on a keyboard.
- Select button that functions similarly to the ENTER key on a keyboard.

The following functions and buttons can also be considered for a remote-control device used with an Entertainment PC 99 system:

- Television button to select the television as the device that will receive input

- Mute button
- Device control buttons, including Volume Up, Volume Down, Channel Up, Channel Down, Fast Forward, Rewind, Play, Stop, Pause, and Record
- Number keys equivalent to a telephone keypad

Keyboard Port and Peripheral Requirements

The primary input component for a PC is the keyboard. An 8042 microcontroller or its equivalent has traditionally controlled the keyboard connection on the system board. However, USB connections and wireless connections are important design considerations for PC 99 keyboards. Also, these design requirements do not exclude (but do not encourage) implementing a legacy AT-style keyboard port.

This section summarizes the specific PC 99 hardware feature requirements for keyboard ports and peripherals. Some keyboard port requirements differ, depending on the type of port being used.

The PC 99 general device requirements are defined in the “System Requirements for I/O Ports and Devices” section earlier in this chapter, including the requirements for a device ID, automated software-only settings for device configuration, device drivers and Windows-based installation, and icons for external connectors.

For requirements that apply if wireless capabilities are provided for the keyboard, see the “Wireless Component Requirements” section later in this chapter.

23. Keyboard connection meets requirements for its bus class

Required

These requirements depend on the type of connection designed into the system and ensure that all Plug and Play requirements are met and that Microsoft drivers support this device.

If a PS/2-style keyboard port is used, it must meet the following requirements:

- Support IRQ 1 on Intel Architecture to ensure the proper functioning of software written for legacy systems, which expect to use this IRQ signal
- Map the I/O address ports to 60h and 64h
- Return expected scan codes, including send ID (0F2h) and response ACK (0FAh), plus 2-byte ID

If a USB connection is used, it must meet the following requirements:

- *USB Specification, Version 1.0* or later
- *USB Human Interface Device Class Specifications, Version 1.0* or later

- Minidriver support based on WDM HID class support in the operating system

If a USB keyboard is the sole keyboard implementation in an Intel Architecture system, it must support the USB Boot Device specification. The system BIOS must provide boot support as specified in the “PC 99 Basic Requirements” chapter in Part 2 of this guide and as defined in *Universal Serial Bus PC Legacy Compatibility Specification, Version 0.9* or later.

24. No interference occurs between multiple keyboards

Required

Mobile PC Note

For example, when a mobile PC is connected to a docking station, more than one keyboard can be attached to the system simultaneously. The keyboard ports on a mobile PC and a docking station must be able to resolve conflicts between the two ports when the mobile unit is docked. Windows supports multiple configurations through the registry and will determine which keyboard to enable.

For more information about managing resources and devices for a mobile PC/docking station combination, see the “Mobile PC 99” chapter in Part 2 of this guide.

25. Keyboard includes Windows and Application logo keys

Recommended

The following are requirements for a keyboard design that includes any Windows logo keys:

- The keyboard must be developed according to technical requirements in *New Key Support for Microsoft Windows Operating Systems and Applications*.
- The keyboard must be compatible at the Windows virtual key-code level.
- The keyboard must pass the requirements in the Windows logo key testing software.
- The Windows logo key must function as a modifier (CTRL, SHIFT, or ALT).
- The Windows Flag trademark must be clearly distinguished on the key top according to the guidelines provided in *New Key Support for Microsoft Windows Operating Systems and Applications*.

The following are recommendations for a keyboard design that includes any Windows logo keys:

- Both left and right Windows logo keys are not required in order to offer full functionality under the Windows operating system.
- The Application key can be a dual-function key and can be used to replace the FN key. In this case, a single press-and-release action sends the scan code for the Application key, and holding this key down while pressing another key will modify it to perform the FN function.

Mobile PC Note

Given the crowded nature of compact keyboards on mobile PCs and keyboards that support double-byte characters (such as Japanese-language keyboards), it might be difficult to add three new keys. For mobile PCs, minimal implementation of new keys includes the addition of one Windows logo key and one Application key.

Game Controller Requirements

This section presents the minimum PC 99 requirements for game-control devices.

The PC 99 general device requirements are defined in the “System Requirements for I/O Ports and Devices” section earlier in this chapter, including the requirements for a device ID, automated software-only settings for device configuration, device drivers and Windows-based installation, and icons for external connectors.

26. Device meets USB HID class specification requirements

Required

PC 99 game-control devices and drivers must support the *USB Human Interface Device Class Specification, Version 1.0* or later.

Wireless Component Requirements

This section summarizes the basic design features for wireless components, provided either as IR or RF adapters.

~~Although there are currently no standards bodies chartered for PC I/O using RF technology, industry standard working groups are expected to make an effort to consolidate various RF wireless I/O systems.~~

IR solutions are based on communication standards developed by the Infrared Data Association (IrDA). The two IR solutions based on IrDA-ratified standards are IrDA Data and IrDA Control (also known as IrBus). A third solution is represented by a variety of legacy unidirectional remote control IR protocols. PC 99 platform makers can choose to support one or more of three IR solutions: IrDA Data, IrDA Control, and legacy remote control IR. However, platform makers are encouraged to use the IrDA standard protocols.

- IrDA Data devices perform point-to-point, bi-directional, narrow cone, high-speed (115 Kb/s to 4 Mb/s), short-range (3 to 6 feet) reliable bulk transfers. The IrDA Data protocol enables file transfers over ad-hoc networks; for example, file transfers among laptop, Personal Digital Assistant (PDA), and desktop systems, and other non-PC devices such as cameras.
- IrDA Control (IrBus) enables simultaneous low-speed (75 Kb/s per device), low latency, relatively long range (up to 20 feet), wide cone reliable communications between multiple devices, such as bi-directional keyboards,

mice, multimedia, and gamecontrols. An IrDA Control specification was approved in early 1998 by IrDA and the first products could ship in late 1998.

- Legacy remote control IR protocols are in wide use today to control consumer-electronics devices such as televisions, VCRs, CD players, and so on. No standard is provided, by IrDA or any other standards body, for legacy remote control devices. PC systems designed to control such devices or to be controlled by existing IR remote controls must accommodate the lack of standards for these unidirectional protocols by adopting a universal consumer-IR approach.

Note that, for many applications, the IrDA Control protocol has some significant advantages over the legacy remote control protocols. The IrDA Control protocol:

- Has the potential to become a world-wide standard.
- Is bi-directional, which enables “smart” control applications that both download and upload information.
- Supports up to eight peripherals simultaneously, using a combination of Time Division Multiple Access (TDMA) and Packet Reservation Multiple Access (PRMA), based on a statistical slotting algorithm.

Use of the IrDA Control protocol is of particular advantage to OEMs that want to bundle multiple wireless control devices with their platform (for example, a mouse, a keyboard, and two gamepads) because a separate dongle does not have to be provided for each control device.

Interoperability is a problem between all three of the IR protocols listed above. While future technology advances may allow some consolidation of IR transceiver ports, this is not expected for PC 99. Therefore, a PC 99 platform must provide a separate transceiver for each protocol it supports. These transceivers must be physically isolated from each other.

If a PC 99 platform advertises itself as supporting all three IR solutions listed above (IrDA Data, IrDA Control, and the universal consumer-IR approach to legacy remote control), it must provide three physically isolated transceivers, one for each protocol, and expose each transceiver to the operating system. For example, the IrDA Control transceiver could be placed on the front of the platform and the IrDA Data and legacy remote control transceivers could be placed on different sides of the platform to provide physical isolation.

If a PC 99 platform advertises itself as supporting two of the protocols listed above (for example, IrDA Data and IrDA Control), it must provide two physically isolated transceivers, one for each protocol.

Many manufacturers are implementing integrated IR solutions for mobile PCs. Various form-factor and environmental issues have limited the adoption of wireless solutions for desktop PCs, including receiver placement in the office

environment and limiting conflicting device signals. USB IR bridging devices or hubs will resolve many of these physical placement issues.

A USB working group is developing guidelines on how USB will interface with both IrDA Data and IrDA Control devices, with first products expected to ship around the end of 1998.

Manufacturers must move their wireless designs to incorporate Fast IR solutions as soon as possible; particularly for mobile platform applications. Fast IR transmits and receives data at speeds of 1.152 Mb/s and 4.0 Mb/s. Fast IR includes design implementations that improve usability. Manufacturers must include Serial IR (SIR) backward compatibility in their Fast IR solutions.

New standards groups for RF communications in the Consumer PC market are emerging; the HomeRF Working Group (HRFWG), which is comprised of computer, telecommunications, and consumer electronics companies, is developing an interoperable RF common air interface called Shared Wireless Access Protocol (SWAP). Manufacturers should be aware of the SWAP specification effort, which will be recommended in future Consumer PC platforms as a standard RF connection.

The requirements listed in this section must be met if wireless capabilities are provided in the system. Power management requirements for wireless devices are defined in the “Power Management for I/O Ports and Devices” section later in this chapter.

IR Requirements

An IR implementation is recommended for all system types, but especially for Entertainment PCs. If IR capabilities are included, the system must meet the basic design features for IR components, devices, and systems specified in this section.

Manufacturers who are implementing designs that include IrDA Control devices are strongly encouraged to join IrDA and to obtain the IrDA-approved version of the IrDA Control specification, plus information on the availability of parts and driver software.

27. IR device uses NDIS 5.0 miniport driver

Required

This requirement applies for IrDA Data devices. An NDIS 5.0, IrDA miniport driver is required for all IrDA Data devices. Full documentation and sample source code for building such a miniport driver can be found in the Windows NT 5.0 DDK.

28. IR device meets IrDA specifications

Required

Recommended: Support specifications for both IrDA Data and IrDA Control devices.

An IR device must be designed to comply with approved IrDA specifications.

If the system is intended to run data transfer applications with other IrDA Data devices, it must be in compliance with the IrDA Data specification.

If an IrDA Control application is used in a PC 99 system, it must be in compliance with the IrDA Control specification, which was approved by IrDA in early 1998. The first IrDA Control-compliant devices could ship in late 1998.

If a system is intended for the consumer market, support for both IrDA Control and IrDA Data is recommended to meet the consumer's expectations for IR device interoperability. The emergence of still-image cameras with IrDA Data capability increases the importance of IrDA Data support in consumer systems.

29. IR device meets PC 99 bus and port specifications

Required

The requirements for all bus classes are defined in Part 3 of this guide. The Windows operating system includes built-in support for devices that use a serial I/O interface; in this case, a wireless device must also comply with the requirements specified in the "Serial Port Requirements" section earlier in this chapter. A device that uses a parallel port must comply with the requirements specified in the "Parallel Port Requirements" section earlier in this chapter. A USB device must comply with the requirements specified in the "USB" chapter in Part 3 of this guide.

30. IR device meets USB guidelines for interfacing with IrDA Data and IrDA Control devices

Required

A USB working group is developing guidelines for how USB is to interface with both IrDA Data and IrDA Control devices. When these guidelines are finalized, they will be PC 99 requirements for USB IR implementations.

31. IR device supports flexible resource configuration and dynamic disable capabilities

Required

Resource configuration support is specified for IR adapters. The adapter must provide flexible resource configuration and complete dynamic disable capabilities following the specifications for the bus or legacy port used. Resource configuration requirements are defined in the Plug and Play specification for the bus that the device uses for its connection.

32. System supports standard input speeds of 4 Mb/s

Required

Device support for input speeds of 4 Mb/s (Fast IR or FIR) is required for all IrDA Data devices.

33. System provides a separate, physically-isolated transceiver for each IR protocol the system supports

Required

This requirement ensures correct implementation for a system that includes IR support for devices that use the IrDA Data protocol, the IrDA Control protocol, and/or the universal consumer-IR approach to legacy remote control, each of which use different device signals. A system that uses only a specific IR device protocol will restrict the ability to use multiple input devices and might also restrict other capabilities.

A PC 99 platform that advertises itself as supporting all three IR solutions listed above (IrDA Data protocol, IrDA Control protocol, and legacy remote control IR) must provide three transceivers, one for each solution, and expose each transceiver to the operating system. These transceivers must be physically isolated from each other; for example, by placing each transceiver on a different edge of the PC 99 platform case. Although some IrDA member companies have tested IrDA Data, IrDA Control, and legacy remote control IR transceivers without spatial separation and demonstrated adequate performance, interference-free operation cannot be assured without physical isolation.

If multiple IR protocols are supported, controllers are expected to provide separate data connections into the PC using USB. The IrDA and USB industry associations define guidelines for how to build and interface such devices. For more information, contact the organizations listed in the “References for I/O Ports and Devices” section at the end of this chapter.

RF Recommendations

Support for RF capabilities is optional. If RF is included, the implementation must meet the PC 99 general device requirements. More specific recommendations are expected as RF standards emerge, especially for Consumer PCs. Manufacturers of Consumer PCs and cordless consumers peripherals such as PC-enhanced cordless telephones or RF wireless data devices are encouraged to join the HomeRF Working Group to obtain information about the SWAP specification. The specification and components required for its implementation are expected to be available in late 1998; until the specification is available, the

Manufacturers who are implementing designs that include RF devices are encouraged to join the USB Implementers Forum and other relevant RF industry associations to work with other manufacturers on standardization of RF protocols and media within the computer industry.

The following recommendations are offered to help designers make appropriate choices if RF solutions are being considered in a particular system design:

- **Select a low-power RF alternative.** For relatively short-range wireless devices that cannot use IR, it is possible to use low-power RF. Use an RF solution appropriate to the application. For example, cordless keyboard and

track-ball devices that need RF instead of Control IR require a maximum range of only 15 to 20 feet.

- **Provide a method to defeat noise and conflict with other RF devices in the environment.** RF devices should be able to defeat noise such as electromagnetic interference (EMI). Also, programmable channel selection, carrier sensing, or the relatively expensive spread-spectrum or frequency-hopping techniques can be used to share the RF medium with other RF devices that might be in the environment.

Many of the issues discussed in this recommendation are addressed by the governing regulatory agencies.

- **Obtain separate local certification for the system and for the RF device.** Rules for certifying low-power, short-range, unlicensed RF devices vary greatly from country to country. By configuring the RF device as a system add-on, local certification of the system will not be blocked while waiting for certification of the RF device, which might take longer. Configuring the RF device as a system add-on also enables adding RF support to legacy hardware.

PC 99 Design Features for Ports

This section summarizes PC 99 requirements related to the design initiatives defined in Part 1 of this guide.

Plug and Play and Bus Design for I/O Ports and Devices

The items in this section are PC 99 requirements for Plug and Play capabilities.

34. Each device has a unique Plug and Play device ID

Required

For a non-bus-specific system-board device, there must be a device-specific ID.

Each bus-specific device must have a Plug and Play device ID as required for the bus it uses, as defined in Part 3 of this guide. For example, a PCI device must comply with PCI 2.1 and also must provide a Subsystem ID and Subsystem Vendor ID, as defined in the “PCI” chapter in Part 3 of this guide. A USB device must comply with the *Universal Serial Bus Specification, Version 1.0* or later, and also must provide a unique ID.

35. Automatic resource assignment and dynamic disable capabilities are supported

Required

The system must be capable of automatically assigning, disabling, and relocating the resources used by this device when necessary, using the method required for the related bus class. When the end user changes this device or adds it to the system, setting of resource assignments must not require changing jumpers or switches on either the adapter or the system board.

In the event of an irreconcilable conflict with other devices on the system, the system must be able to disable the device to prevent the system from stalling. If there is a conflict where more than one port or device of the same type is detected on the system, then one of two methods can be used to resolve it:

- Completely disable the built-in port or device.

For example, if there is a conflict when a second serial port is added to a desktop system, the expansion card overrides the system-board device. Using this method, the system disables the device on the system board and enables the expansion card only. This is the recommended conflict-resolution method for add-on serial, parallel, Musical Instrument Digital Interface (MIDI), and joystick devices.

Or if an expansion card, such as a display adapter with a built-in pointing-device port, is added to a desktop system that has a system-board pointing-device port, then the expansion card overrides the system-board pointing-device port. Using this method, the system disables the pointing-device port on the system board and only accepts pointing-device input from the expansion card.

- Both ports and devices remain active while resolving any conflict by relocating the resources of one or both devices.

Using this method, either device can be used. For example, in a docking system, the pointing device on a mobile PC and the pointing device on a docking station can be allowed to share pointing responsibilities. Either pointing device can be used, although the software will use only one.

Note: Fixed (static) resource devices can exist to support standard devices, including the keyboard controller (8042). For a system based on Intel Architecture, these fixed resources are located at I/O addresses under 100h. Standard system-board devices should use their ISA-compatible addresses. For a system based on Intel Architecture, this includes devices with I/O port addresses within the reserved range 0h–0ffh. For more information about legacy resources and ISA-compatible addresses, see the “Legacy Support” appendix in the References part of this guide.

Power Management for I/O Ports and Devices

This section summarizes the specific PC 99 power management requirements for I/O ports and devices.

36. Each device complies with its device class power management reference specification

Required

The related device class power management reference specification applies for each specific type of device. For example, for an input device, the *Input Device Class Power Management Reference Specification* is the relevant specification.

These specifications also cover device functionality expected for each power state and possible wake-up event definitions for each class. Power states D0 and D3 are required.

37. Device supports wake-up events

Required for wireless input;

Optional for other devices

For PC 99, the ability to cause a wake-up event as defined in the device class power management reference specification is required for wireless input devices. It is optional for other devices.

Device Drivers and Installation for I/O Ports and Devices

This section summarizes PC 99 device driver requirements for I/O ports and devices. The items in this section are requirements for all PC 99 systems.

38. Device drivers and installation meet PC 99 requirements

Required

The manufacturer does not need to supply a driver if a PC 99-compliant driver provided with the operating system can be used. If the manufacturer supplies a driver, the requirements for the device driver and installation are defined in the “PC 99 Basic Requirements” chapter in Part 2 of this guide.

The basic requirements include driver support for unattended installation and Help file support if special driver parameters are used.

For input devices that use USB connections, driver support must be implemented as a minidriver under the WDM HID support provided in the Windows and Windows NT operating systems.

39. All PC 99 input devices support Microsoft DirectInput and work simultaneously

Required

All input devices implemented in a PC 99 system must have drivers that support Microsoft DirectInput. All input devices must also be able to correctly provide simultaneous input. This means that no input device is automatically disabled when another input device is in use.

Note: The built-in drivers provided with Windows 98 and Windows NT 5.0 meet this requirement. For information about implementing drivers that support simultaneous use of devices, see the Microsoft DirectX DDK, available through MSDN Professional membership.

References for I/O Ports and Devices

The following represents some references, services, and tools available to help build hardware that is optimized to work with Windows operating systems.

Device class power management reference specifications

<http://www.microsoft.com/hwdev/onnow.htm>

HomeRF Working Group

<http://www.homerf.org>

IBM Personal System/2 Common Interfaces, Part No. S84F-9809

IBM Personal System/2 Mouse Technical Reference, Part No. S68X-2229

International Business Machines Corporation

IBM Customer Publications Support

Or contact an IBM sales representative

IEEE specifications

ASK*IEEE

Phone: (800) 949-4333

Fax: (212) 310-4091

E-mail: askieee@ieee.org

<http://www.ieee.org>

Global Engineering Documents

Phone: (800) 854-7179 (US)

(613) 237-4250 (Canada)

(303) 792-2181 (Outside North America)

Fax: (303) 397-2740

<ftp://ftp.symbios.com/pub/standards/io/>

Infrared Data Association

Serial Infrared (SIR) Physical Layer Specification

Control IR (CIR or IrBUS) Specification

Available only to IrDA members:

Infrared Data Association

PO Box 3883

Walnut Creek, CA 94598 USA

Phone: (510) 943-6546

Fax: (510) 943-5600

E-mail: irda@netcom.com

New Key Support for Microsoft Windows Operating Systems and Applications

Newkeys.zip (self-extracting zip file)

ftp://ftp.microsoft.com/PerOpSys/Win_News

Plug and Play specifications

<http://www.microsoft.com/hwdev/respec/>

USB specifications

USB HID Usages Table

USB Implementers Forum

Phone: (503) 264-0590

Fax: (503) 693-7975

<http://www.usb.org>

Universal Serial Bus PC Legacy Compatibility Specification, Version 0.9

http://www.teleport.com/~usb/data/usb_le9.pdf

Windows NT DDK and Windows DDK

MSDN Professional membership

Checklist for I/O Ports and Devices

If a recommended feature is implemented, it must meet the PC 99 requirements for that feature as defined in this document.

Consumer PC 99	Office PC 99	Entertainment PC 99
1. System includes connection for external serial devices <i>Required</i>	<i>Required</i>	<i>Required</i>
2. System includes connection for external parallel devices <i>Required</i>	<i>Required</i>	<i>Required</i>
3. System includes external connection for keyboard <i>Required</i>	<i>Required</i>	<i>Required</i>
4. System includes pointing-device connection and pointing device <i>Required</i>	<i>Required</i>	<i>Required</i>
5. System includes USB game pad or joystick <i>Recommended</i>	<i>Recommended</i>	<i>Recommended; wireless</i>
6. System includes built-in wireless capabilities <i>Recommended</i>	<i>Recommended</i>	<i>Recommended</i>
7. Devices use USB or external bus connections rather than legacy serial or parallel ports <i>Required</i>	<i>Recommended</i>	<i>Required</i>
8. All devices meet PC 99 general device requirements <i>Required</i>	<i>Required</i>	<i>Required</i>
9. Serial port meets device class specifications for its bus <i>Required</i>		
10. Legacy serial port is implemented as 16550A UART or equivalent and supports 115.2K baud <i>Required</i>		
11. Legacy serial port supports flexible resource configuration and dynamic disable capabilities <i>Required</i>		
12. Conflict resolution for legacy serial port ensures availability of at least one serial port <i>Required</i>		
13. Parallel port meets device class specifications for its bus <i>Required</i>		
14. Flexible resource configuration supported for each parallel port		

Required

15. EPP support does not use restricted I/O addresses

Required

16. Compatibility, nibble mode, and ECP protocols meet IEEE 1284-1994 specifications

Required

17. Port connectors meet IEEE 1284-I specifications, minimum

Required

18. IEEE 1284 peripherals have Plug and Play device IDs

Required

19. Device identification string provides CompatibleID key

Recommended

20. Daisy-chained parallel port device complies with IEEE 1284.3

Required

21. Pointing-device connection meets requirements for its bus class

Required

22. Remote control provides PC 99 minimum support

Recommended

23. Keyboard connection meets requirements for its bus class

Required

24. No interference occurs between multiple keyboards

Required

25. Keyboard includes Windows and Application logo keys

Recommended

26. Device meets USB HID class specification requirements

Required

27. IR device uses NDIS 5.0 miniport driver

Required

28. IR device meets IrDA specifications

Required

29. IR device meets PC 99 bus and port specifications

Required

30. IR device meets USB guidelines for interfacing with IrDA Data and IrDA Control devices

Required

31. IR device supports flexible resource configuration and dynamic disable capabilities

Required

32. System supports standard input speeds of 4 Mb/s

Required

33. System provides a separate, physically-isolated transceiver for each IR protocol the system supports

Required

34. Each device has a unique Plug and Play device ID

Required

35. Automatic resource assignment and dynamic disable capabilities are supported

Required

36. Each device complies with its device class power management reference specification

Required

37. Device supports wake-up events

Required for wireless input;

optional for other devices

38. Device drivers and installation meet PC 99 requirements

Required

39. All PC 99 input devices support Microsoft DirectInput and work simultaneously

Required